INERT PUMP LEG ADAPTED FOR IMMERSION IN MOLTEN METAL

Cross-Reference to Related Application

This application is a continuation-in-part of application Serial No. 09/130,937, filed August 7, 1998 for "Advanced Motor Driven Impeller Pump for Moving Metal in a Bath of Molten Metal", now U.S. Patent No. 6671074.

Background of the Invention

This invention is related to a structure for supporting a pump or similar apparatus immersed below the metal level of a bath of molten metal, such as aluminum or zinc.

In my aforementioned co-pending patent application, I disclosed a vertical post or leg for supporting a pump immersed in a bath of molten metal beneath an overhead structure above the bath of molten metal. Certain pumps disclosed in my prior patent application are buoyant in a bath of molten metal because of their lower specific density. In order to locate the pump in a suitable position below the metal level, it is desirable to have one or more overhead support legs. I disclosed a support leg having a ceramic sleeve extending between the overhead structure and the pump. The ceramic sleeve material is resistant to the heat of the molten metal. An internal vertical graphite leg is disposed in the sleeve. The graphite leg has sufficient compressive strength to support the pump in the bath of molten metal but has a tendency to burn in the presence of heat and oxygen. I disclosed a means for protecting the graphite leg by providing an internal chamber around the graphite leg and in the ceramic sleeve. An inert gas, such as nitrogen, protects the graphite from burning. However, I have found in some cases it is unnecessary to have a gas filled chamber in the sleeve to protect

the graphite. Further, I have found novel means for introducing an inert gas into the ceramic sleeve to prevent burning of the graphite.

Summary of the Invention

The broad purpose of the present invention is to provide an improved vertical leg structure for supporting a pump immersed in a bath of molten metal beneath an overhead structure disposed above the molten metal. In the preferred embodiment of the invention a ceramic sleeve extends between the overhead structure and the pump housing. It has a sufficient height to hold the housing in the bath of molten metal. An internal leg of a graphite material is disposed in the sleeve to provide a vertical support between the overhead structure and the pump housing.

A slight clearance between the ceramic sleeve and the graphite leg forms a chamber which is filled in various ways by both, gaseous and non-gaseous but inert materials. The leg comprises a vertical ceramic sleeve housing and a vertical graphite leg that extends between the overhead supporting structure and the pump housing. The sleeve covers that portion of the graphite exposed to the heat of the molten metal and above the metal line where severe burning of the graphite would occur due to the oxygen present in air.

Still further objects and advantages of the invention will become readily apparent to those skilled in the art to which the invention pertains upon reference to the following detailed description.

Description of the Drawings

The description refers to the accompanying drawings in which like reference characters refer to like parts throughout the several views and in which:

FIGURE 1 shows a ceramic sleeve shielding a leg disposed in an atmosphere containing an inert gas;

FIGURE 2 is a view of an alternative means for connecting the lower end of the leg to the pump housing;

FIGURE 3 is a view of another support leg in which the graphite is shielded by a inert gas;

FIGURE 4 is a view as seen along lines 4-4 of Figure 3;

FIGURE 5 is a view in which the sleeve provides an inert chamber containing inert non-gaseous materials for protecting the graphite leg;

FIGURE 6 is a view as seen along lines 6-6;

FIGURE 7 is an enlarged fragmentary view of the inert chamber; and

FIGURE 8 is still a further enlarged view showing the manner in which a nylon tape is wrapped around the leg to form a double chamber containing a porous cement.

Description of the Preferred Embodiment

Figure 1 shows a shielded leg 10 supporting a pump housing 12 beneath the metal level 14 of a bath of molten metal, such as aluminum or zinc. The upper end of the leg is connected to a cover plate 16.

The cover plate has an opening 18. An annular plate 20 is mounted on the underside of the cover plate and has a central opening 22 aligned with opening 18. A fitting 24 has a gas-receiving passage 26 for receiving an inert gas, such as nitrogen, from a source of nitrogen 28 through conduit means 30.

The pump housing has a frusto-conical opening 32 which extends between its upper and lower surfaces. A sleeve formed of a ceramic material that is resistant to the heat of the molten metal is mounted between mounting plate 20 and the top surface of

the pump housing around opening 32. Sleeve 34 has a cylindrical configuration and has its upper and lower ends seated against mounting plate 20 and the pump housing, respectively.

A graphite leg 36, having a sufficient diameter to provide a structured support between cover plate 16 and pump housing 12, has its upper end abutting the mounting plate and its lower end formed with a reduced frusto-conical exterior surface that is seated in opening 32. The lower end 40 of the graphite leg is threaded for receiving a fastening nut 42.

Mounting plate 20 is attached by fastener means 43 to the cover plate.

A cement, modified by adding boron nitrite or boronit paint (obtainable from Alphatech, Inc., Cadiz, KY) is coated between the outer surface of the graphite leg, in the areas of the thicker line 44, and the ceramic sleeve, as well as between the lower end of the leg seated in opening 32, and the upper end of the leg in contact with the cylindrical skirt 45 of the mounting plate to provide a seal between the ceramic sleeve and the graphite leg that prevents the penetration of the molten metal.

A Kawool gasket 48 is mounted between the upper end of the leg and the mounting plate.

The graphite leg material has sufficient porosity to impregnate with the inert gas and create a chamber of inert nitrogen gas that prevents a combustible gas from permeating inside the ceramic sleeve to burn the graphite leg.

Referring to Figure 2, an alternative means for connecting leg 36 to pump housing 12 is illustrated in which the lower end of the leg has been enlarged to provide a frusto-conical outer surface at 50 that mates with a frusto-conical interior opening 52

in housing 12 to provide a simple disassemble and removal of a damaged leg eventuity.

The diameter of the leg is slightly smaller than the inner surface of the sleeve and of opening 52. A suitable inert cement 56 occupies the space between the ceramic shield and the leg.

Referring back to Figure 1, the graphite leg has an axial passage 58 connecting passage 24 so that the inert gas (nitrogen) can pass along the major length of the leg. The graphite is sufficiently porous to house the inert gas and prevent the entry of either air or molten metal inside the sleeve - leg chamber.

Figure 3 illustrates another embodiment of the invention. In this case, cover plate 16 provides an overhead supporting structure above metal level 14. Pump housing 12 is immersed in the bath of molten metal. Mounting plate 20 is disposed on the under side of the cover plate and connected by fitting 60 to a source of nitrogen under pressure 28 through conduit 30. Ceramic sleeve 62 has its upper end in abutment with a Kawool gasket 64 on the underside of the mounting plate to create a sealed chamber between the ceramic sleeve and graphite leg.

The sleeve extends through a cylindrical opening 66 in the pump housing and is cemented by a suitable inert cement to the pump housing in the area indicated by heavy line 80. Graphite leg 70 is housed inside the sleeve and has at its lower end an enlargement to engage and support the pump housing. The outer diameter generally corresponds to the inner diameter of the sleeve but allowing for any desirable (not necessary) refractory cement 80 to join the leg to the sleeve and for thermal expansion. The upper end of the sleeve also abuts gasket 64. The lower end of the sleeve extends to the inner surface of the pump housing.

6

The graphite leg is formed with an external helical groove 68 which extends from its upper end to its lower end. Referring to Figure 4, the groove has an upper end 72 in communication with a radial channel 74 in the leg. The inner end of channel 74 terminates with a vertical passage 76 which is connected to conduit 30. Thus the nitrogen gas forms a helical shield around the vertical leg extending from its upper end to its lower end. A ceramic ring 78 is cemented to the sleeve to aid in preventing pump housing 12 from any vertical movement.

Figures 5-8 show still another embodiment of the invention in which a ceramic sleeve 100 has its lower end in abutment and sealed with the pump housing. The upper end of the sleeve extends above metal level 14 to a position adjacent mounting plate 20.

A graphite leg 102 has its upper end in abutment with mounting plate 20 and its lower end seated in an opening 104 in the pump housing. The lower end of the leg has an annular groove 106. The housing opening 104 has an annular groove 108. The lower end of the leg is slightly smaller than the housing opening. Grooves 106 and 108 and the space between the lower end of the leg and the housing opening ~~is~~ are filled with a cement in the area of the heavier line 110 to prevent any molten metal from entering the lower end of the ceramic sleeve, and to join the leg to the housing.

The leg has an outer diameter smaller than the inside diameter of the sleeve to provide a tubular chamber 112. Preferably the chamber has a thickness, as illustrated in Figure 7, filled with respectively, a mix of boron nitride paint and a suitable refractory cement coating 114, a nylon tape 116 and outer layer 118, also a mix of cement and boron nitride paint. The nylon tape is cemented by a combination of the refractory cement and boron nitride paint which constitutes inner and outer layers 114

and 118. The nylon tape is wrapped in a helical wrapping as illustrated in Figure 5 from the bottom of the cylindrical skirt 120 of the mounting plate 20 to the pump housing. When the cement mix has dried, an additional layer is applied over and around the helical tape to form layer 118. Prior to the cement mix drying, this arrangement is then disposed inside the sleeve to form a gas-free environment between the leg and the sleeve now filled with inert materials that shield the graphite ~~sleeve~~ Leg from burning gases.

Figure 8 is an enlarged view of the manner in which the tape is wrapped. It is preferably wrapped in an overlapping arrangement as illustrated at 122. Thus the nylon tape provides double cylindrical chambers of a ceramic low porosity cement which is both inert and non-wetting in aluminum. The boron nitride reduces the porosity of the cement and simultaneously increases the surface tension thereby eliminating the ability of molten aluminum or molten zinc to penetrate between the ceramic sleeve and the graphite leg.

Having described my invention, I claim: